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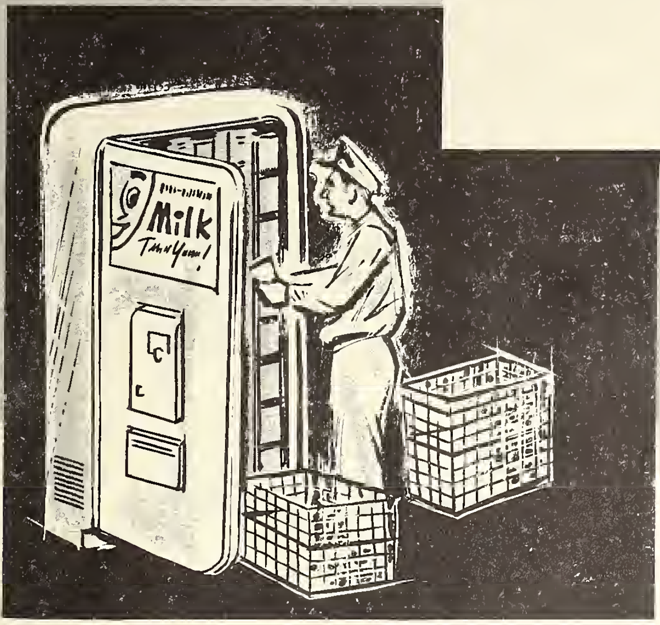
COSTS of DISTRIBUTING MILK

through VENDING MACHINES and by RETAIL and WHOLESALE ROUTES,

Martinsburg, W. Va.



Marketing Research Report No. 229

Agricultural Marketing Service
Marketing Research Division

7

UNITED STATES DEPARTMENT OF AGRICULTURE

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Issued May 1958

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 25 cents

SUMMARY AND CONCLUSIONS

This study covers the relative costs of distributing milk through vending machines and by retail and wholesale routes in and around Martinsburg, W. Va. This study, and another for the purpose of determining the effect of selling milk in vending machines on milk consumption in the market, were made concurrently.

At most vending machine locations observed in this study, sales reached a peak soon after the machines were installed, due possibly to the novelty effect. In some locations, sales leveled off at a lower volume, but generally there was a gradual decline. Increased sales volume per machine apparently can be most readily attained by seeking out more advantageous locations, and moving machines to such places.

To keep the unit cost of vending low and increase the probability of profitable operation, the sales volumes of individual vending machines should be increased, and variable operating costs should be decreased.

Under the conditions observed in this study, operating costs can be reduced by servicing the vending routes every-other-day rather than daily. Another possibility is to service the machines in connection with existing conventional distribution routes. Driving costs were relatively important in observations made in this study. This suggests that variable operating costs might be lowered significantly by rerouting delivery or by a closer grouping of vending locations.

Unit fixed costs of vending might be minimized by selecting machines that are appropriate for the locations in which they will be used. For example, machines selected for filling stations, which do not have peak periods of use, could be manually operated while those in schools which do have peak periods should be automatic in operation. Automatic machines also have larger vending capacity, they eliminate pilferage, and are easier for smaller children to operate. Similar considerations regarding machine type should govern the selection of outdoor milk vending machines, with particular attention being given to the size or sizes of containers to be vended.

Gross margins varied among products sold in the vending machines. Thus some incentive exists to vend high-margin items that have relatively few sales in addition to the lower margin items that are more generally in demand. For example, in the model indoor vending route the addition of half-pints of dairy orangeade in machines already vending half-pints of chocolate milk and homogenized milk, would result in a drop in the break-even point from 1,604 units to 1,549 units.

The cost of distributing dairy products through vending machines was high in relation to the cost of their distribution on either every-other-day retail routes or wholesale routes. This high cost can be expected because of the complementary and marginal nature of the milk vending in relation to other methods of distributing dairy products during the period of the study. The higher cost of vending is attributable to the high unit costs of the vending machine and to the location rental.

Cost per dollar of sale on the 3 model vending machine routes in this study ranged from about 1.5 to 3.5 times as great as costs for the model wholesale route.

Every-other-day retail routes had unit operating costs comparable to those of the wholesale routes observed in this study. The unit operating cost of a route serving outdoor vending machines was comparable to the costs of daily delivery to homes, the highest unit operating costs of all distribution methods observed. When operated every-other-day, retail routes delivering to homes had a lower operating cost per sales dollar than wholesale routes, but this cost became twice that of the wholesale route when retail delivery was made daily.

COSTS OF DISTRIBUTING MILK THROUGH VENDING MACHINES AND BY RETAIL AND WHOLESALE ROUTES, MARTINSBURG, W. VA.

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INTRODUCTION

This study of the costs of operating vending machine routes was made concurrently with work carried on by West Virginia University and the Marketing Research Division, Agricultural Marketing Service to determine the impact on total milk consumption of introducing milk vending into a market. 1/ The study is a part of a broad program of research intended to reduce costs of marketing farm products. This report describes the operations and compares the costs of milk distribution by vending machine, home delivery, and wholesale routes, when vending is carried on as a marginal method of distribution that complements rather than competes with wholesale and retail route distribution. It is based on observations made of delivery operations and costs obtained from three milk handlers and one specialized vending company operating in and around Martinsburg, W. Va. The objective of this report is to present both the physical and monetary costs involved in milk vending that would serve as guides in determining the feasibility of instituting vending operations under similar circumstances. A secondary objective is to indicate the cost of vending relative to the costs of the distribution system in that market.

Surplus milk supplies and rising costs have increased interest for new milk merchandising methods in the dairy industry. The sale of milk through vending machines is one method that has been successful in many areas during the past few years. Milk vending started in this country during the mid-thirties but was unsuccessful because of mechanical difficulties. Interest in vendors revived during World War II when labor shortages existed, and continues to the present.

Vending has not yet found its place in milk distribution. The dairy industry has tended to regard it as a method of distribution that complements the established retail routes and wholesale route-store methods of distribution. Thus, vending has been used primarily to make milk available in places where the conventional methods of distribution cannot readily or efficiently serve some fraction of the public.

1/ A report is being prepared jointly by the University of West Virginia and the Agricultural Marketing Service regarding the effect of vending machines on total consumption in Martinsburg.

Yet there are indications that this may not be the only role of vending. In some cities vending machines have been placed in apartment houses and have been tried in locations adjacent to chainstores. Locations like these make vending competitive with store and home-delivered sales. This concept of the role of vending would result in a much different organization of milk and dairy product distribution than one where sales through vendors merely complemented store and home-delivered sales. Competitive vending operations might result in prices, sales per machine, and costs, as well as locations, that would be greatly different from those in complementary operations.

As yet, empirical study of situations where vending competes with conventional distribution has not been feasible. Nevertheless, studies in markets where vending is complementary to other distribution can afford insight into the cost conditions which must be taken into account if vending is to be developed as a competitor of conventional wholesale and retail distribution.

Studies of milk vending costs completed or now under way at various experiment stations, have, in general, been concerned with operating costs and the volume of sales necessary to break even, but have not afforded information on costs of other methods of distribution.

The present study shows, insofar as possible, the physical inputs necessary for vending, wholesale, and home-delivery distribution, and translates them into cost data reflecting conditions in the market at the time of the study. The labor time required for various steps in the different milk distribution methods was observed and recorded in January, April, July, and October 1956, to determine if any seasonal differences existed. Since no seasonal differences were found, the labor time and other inputs reported in this study represent an average of the four observations.

Labor requirements for each of the methods and frequencies of delivery differed among the dairies and also among similar routes operated by the same dairy. Owing to the variation in labor and other cost elements, within and among methods, it seemed advantageous to develop a "normal route" for each method. Costs were estimated for these model routes on the basis of: (1) Averages of the labor and mileage requirements for individual routes; and (2) information on costs of capital investment, depreciation, maintenance, taxes and licenses, location rental, and other overhead items obtained from the milk distributors.

The operation of vending machines in schools was not included in the present study, because it is carried out under conditions that make it a specialized operation, not typical of machines in other locations.

COSTS OF VENDING

Route Organization and Labor Utilization in Martinsburg, W. Va.

Indoor Vending by a Dairy

Route Information

Route operation in Martinsburg, W. Va., began at approximately 8 a. m., to avoid the early morning traffic rush. The route was serviced 6 days each week and each vendor was serviced daily unless for some reason the location was closed. No deliveries were made on Sundays.

The vending machines used were the automatic, indoor, multiple choice type. Chocolate milk, homogenized milk, and occasionally dairy orangeade or buttermilk in pint or one-half-pint paper containers were the products vended. All vending machines were in industrial locations.

Eight vending machines were serviced on this route during the first observation. This number increased to 9 for the second, 12 for the third, and 14 for the fourth observation. An average of 404 ½-pints were placed in the machines per observation, or approximately 37 ½-pints for each machine. The routeman placed only as many units in any machine as he estimated would sell before the next servicing, insuring fresh milk at all times. Frequently, persons who observed the machine being refilled made a purchase or requested change in order to make a purchase later.

Once a week, receipts were collected and an inventory was made as a part of servicing. Location rental was paid by check every 4 weeks at the rate of 10 percent of gross sales.

The distance between vending locations averaged 2.25 miles. This average distance was greatly increased by servicing one location approximately 10 miles beyond the city limits. The average distance between locations within the city limits was a half mile.

Labor Requirements

Driving on this route required approximately 1 hour and took 45 percent of total route time (table 1). This was more time than any other labor classification required.

Table 1.--Operations included in servicing a milk vending machine route and their relative importance, average of 4 observations, Martinsburg, W. Va., 1956 1/

Operation	Average time		Average percent of total route time
	Minutes	Seconds	
Loading	2	19	2
Driving	61	43	45
Delivery			
Trip I			
Entering	5	6	4
Servicing	34	10	25
Returning	4	48	3
Total	44	4	32
Trip II			
Returning	1	16	1
Reenter	1	15	1
Servicing	5	51	4
Total	8	22	6
Unload	1	26	1
Check-in	14	52	11
Personal	4	14	3
Total	137	00	100

1/ The route served an average of 11 machines.

Delivery of products from the truck to the vending machines was timed in three parts: (1) "Entering" or carrying the products to the machine; (2) "servicing" which included refilling, cleaning, removal of receipts, taking inventory and making mechanical adjustments; and (3) "returning" to the truck. (Removal of receipts and making weekly inventory became the routeman's responsibility in May 1956.) Any additional trips were also timed in three parts.

First delivery trips used 32 percent of route time and required approximately 3/4 of an hour. The 32 percent of route time included 4 percent spent entering, 25 percent servicing, and 3 percent returning.

Second delivery trips were made an average of 1.75 times per observation, adding 6 percent to total route time. In this case returning was 1 percent; reentering was 1 percent; and additional servicing 4 percent.

Loading and unloading added 3 percent to route time. This time requirement was low because of the relatively small daily volume, the handling of case lots of milk, and the use of lightweight paper containers.

"Check-in" required 11 percent of route time. This does not include that part of the routeman's bookkeeping that was done by office personnel.

Personal time was used only during the January and July observations and averaged 3 percent of route time. It is possible that personal time would increase on longer routes or with bad weather.

Special Collection and Inventory

The weekly collection and inventory were made by the plant manager at the time of the January and April observations. The average labor requirements for these trips were 51 percent for driving, 7 percent for entering, 35 percent for servicing, and 7 percent for returning (table 2). Bookkeeping and counting of receipts were done by office personnel. The average time required to complete the collection and inventory was approximately 1 3/4 hours. On the basis of 6-day delivery, this added an average of 17 minutes to each day's total required route time.

Indoor Vending by a Vending Company

Route Information

A company specializing in vending machine sales operated 4 automatic, multiple choice, indoor milk vending machines in addition to machines vending other products in an industrial plant. Chocolate milk, homogenized milk, buttermilk, and dairy orangeade were vended through these machines in one-half-pint paper containers. The milk vending machines were owned by the two dairies supplying the dairy products. This arrangement increased the vending company's sales potential and provided the dairies an outlet for additional sales. The vendor operator alternated his milk purchases from week to week between the participating dairies. The dairies have experienced difficulty in anticipating bottling requirements as vending sales fluctuated from day to day.

The dairies delivered milk to the vendor operator at the entrance of the plant where the vending machines were located. Deliveries were usually made every other day but may be made more frequently if the demand requires it. The dairy products were placed on a cart with other vend items for movement to the vending locations. Each milk vending machine was located in a "battery" with other machines.

Table 2.--Operations included in collecting from a milk vending machine route and their relative importance, average of 2 observations, Martinsburg, W. Va., 1956

Operation	Average time		Average percent of total route time
	Minutes	Seconds	
Drive	52	30	51
Enter	7	12	7
Service	36	10	35
Return	7	15	7
Total	103	07	100

Observations of this milk vending operation were made once each in July and October 1956.

Labor Requirements

Walking between the vending locations averaged 28 1/3 minutes or 55 percent of the time required to go to all 4 vending locations (table 3), and included time spent making change or talking to plant personnel.

Servicing the vending machines required an average of 22 3/4 minutes or 45 percent of the trip time and included refilling, cleaning, and making mechanical adjustments. The number of units replaced was recorded daily on a form kept inside the machine and it was totaled monthly. Receipts were removed weekly. [2]

The total average time required to service all 4 machines was slightly over 51 minutes. Servicing all machines in this plant required one man's full time, and he was able to service each location approximately every 2 hours of the workday.

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[2] It was assumed for purpose of timing that only milk vending machines were serviced. Additional average labor of 10 3/4 minutes was required of a routeman from the participating dairy for each delivery made to the vendor operator. This consisted of 3/4 minute for loading, 5 ½ minutes for driving the 1 mile round trip, and 4 ½ minutes to make the delivery.

Table 3.--Operations included in servicing a specialized milk vending operation located in a manufacturing plant, and their relative importance, average of 2 observations, Martinsburg, W. Va., 1956

Observation	Average time		Percent of total time
	Minutes	Seconds	Percent
Walking	28	20	55
Servicing	22	45	45
Total	51	05	100
Number of vendors		4	

Outdoor Vending by a Dairy

Route Information

Only one large outdoor vending machine was operated in this market. It was on the premises of the operating dairy and vended homogenized milk in both quart and one-half-gallon paper containers.

The dairy believed the main benefit of this machine to be its advertising value, not increased milk sales. In fact sales were limited by its "out-of-the-way" location, and the lack of sales promotion to encourage consumer acceptance. Promotion was limited because retail grocers, who purchased their dairy product supplies from this dairy, objected to the vending of milk by the dairy in this manner.

The vending machine was serviced as frequently as necessary by a plant employee. Milk was carried, by hand, the short distance from the plant cooler room to the machine.

Since the operation involved no increment of labor for the plant, no observations were made of the labor requirements.

Combined Outdoor and Indoor Vending by a Dairy

Route Information

Two observations, one each in July and October 1956, were made of a milk vending route that serviced both outdoor and indoor type vending machines. This route operated from Martinsburg although all vending locations were outside its immediate marketing area.

The route serviced 6 outdoor type machines, each located at or adjacent to a filling station. The outdoor machines vended quarts of homogenized milk and $\frac{1}{2}$-pints of chocolate milk in paper containers.

In addition, the route serviced an average of 20 locations having automatic, multiple choice indoor type machines, which vended homogenized milk and chocolate milk in one-half-pint or pint paper containers. Indoor type vending machines were located in such varied places as filling stations, garages, industrial plants, office building, and the freight yards and repair shops of a railroad.

Each location was readily accessible for servicing. However, servicing the machines in the freight yards required driving over some poor roads, walking across tracks, and waiting for trains to pass. Servicing machines located in the repair shops was facilitated by using a 2-wheel cart.

All outdoor type machines and those in the railroad freight yards were serviced daily. Other locations were serviced less frequently, some each day the location was open, and some every other day.

Receipts were removed daily from each machine serviced and a running inventory of the contents of the individual vending machines was kept.

Labor Requirements

This route was estimated by the operator to be 75 miles long. Driving required approximately 3 $\frac{1}{4}$ hours or 38 percent of route time (table 4). Most of the driving was through rural areas although the vending machines were in urban locations.

Delivery of products from the truck to the machines utilized 3 hours, 52 minutes which was 46 percent of route time. Delivery was timed in 3 parts: (1) Entering the location; (2) servicing the machine; and (3) returning to the delivery truck. Entering averaged 37 minutes and returning 17 minutes or 7 percent and 4 percent of route time, respectively. 3/ Servicing the machines required approximately 3 hours or 35 percent of route time.

3/ Time spent between vending locations in the railroad repair shops was classed as entering. Several locations were such that the delivery truck could park next to the machine and entering and returning time was negligible.

Table 4.--Operations included in servicing a milk vending route with both outdoor and indoor type vending machines and their relative importance, average of 2 observations, Martinsburg, W. Va., 1956

Operation	Average time required		Average percent of total time
	Minutes	Seconds	Percent
Loading	9	15	2
Icing	2	30	1/
Driving	194	10	38
Delivery			
Enter	37	---	7
Service	178	27	35
Return	17	30	4
Total	232	57	46
Personal	44	40	9
Unload	8	57	2
Check-in	16	57	3
Total	509	26	100

1/ Less than 1 percent.

Loading required 9 ¼ minutes and icing the load 2 ½ minutes. These were 2 percent of route time. Unloading was done in 9 minutes, or 2 percent of route time. Both loading and unloading the truck, which was done by the routeman and a "cooler man," was facilitated by use of a roller track and a powered endless belt.

Personal time for lunch averaged three-fourths of an hour, increasing route time 9 percent.

Check-in or accounting for the difference between the volume loaded out and returned required approximately 17 minutes, or 3 percent of route time.

Total route time was 8 ½ hours from loading through check-in.

Model Route Organization and Operating Costs

Model routes were constructed from the average time requirements of the observed routes, using cost conditions for vending operations found in Martinsburg; they do not necessarily represent the kind of route that would develop under different circumstances. 4/ For example, in areas with a heavier concentration of population than Martinsburg, miles between machines might be fewer; driving time less; and more time available for servicing machines so that more machines might be included in a given route.

Each model route was constructed to require a total of 7 hours daily so it would offer full-time employment competitive with alternative employment opportunities. Costs were allocated on a daily basis to provide for differences in frequency of route operation.

Routes of the different types constructed on this basis can be compared simply and directly. They also afford a method and a yardstick by which costs and returns for vending operations in other locations can be studied and appraised.

Indoor Vending in Industrial Locations by a Dairy

Route Information

It is assumed that 30 milk vending machines in industrial locations are serviced on this route. The machines are of automatic, multiple choice, indoor type, vending $\frac{1}{2}$-pint paper containers of homogenized milk, chocolate milk, and on some occasions, dairy orangeade. Each item sells for 10 cents. The distance between vending locations averages 2 $\frac{1}{4}$ miles, for a total route distance of 67 $\frac{1}{2}$ miles. This route is serviced by 1 man.

Operating Costs

The hourly labor rate of $1.25 is an important factor of cost. 5/ Driving takes 45 percent of the routeman's time and costs $3.95 daily (table 5). Delivery requires 38 percent of the route time and has a

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4/ All costs in the short run are fixed but become variable as the time period is increased.

5/ The labor rate for this study is based on a guaranteed weekly wage and a 40-hour work week. In general, the routeman's wages are based on a small base salary plus a commission on sales, plus a fee for each collection. The sum of these will generally approximate the guarantee.

daily cost of $3.36. Driving and delivery together account for 83 percent of the total daily cost of $8.77 and offer the best opportunities for reducing labor costs.

Table 5.--Daily labor requirements and costs for a model milk vending route of 30 indoor machines: Based on vending operations in Martinsburg, W. Va., 1956

Operation	Average percent of total required time	Average time required		Allocated labor cost ($1.25/hour)
	Percent	Minutes	Seconds	Cents
Loading	2	7	6	0.15
Driving	45	189	24	3.95
Delivery				
Trip I				
In	4	15	30	.32
Service 1/	25	105	2/	2.19
Out	3	14	42	.32
Total	32	135	12	2.83
Trip II				
Out	1	3	24	.07
In	1	3	48	.08
Service	4	18	6	.38
Total	6	25	3/ 18	.53
Unload	1	4	12	.09
Check-in	11	45	24	.94
Personal	3	13	24	.28
Total	100	420	00	4/ 8.77

1/ Four one-half pints, on an average, could be placed in the machine in 5 seconds; the remaining time was utilized for cleaning, checking the mechanism, coin refill, etc.

2/ 82.5 minutes fixed, and 22.5 minutes variable time.

3/ Second trip assumed to be variable time.

4/ Differences are due to rounding.

Truck operating costs, excluding the routeman's wages, are 16.2 cents per mile, or $10.94 for the 67½ miles of the route (table 6.) 6/

Table 6.--Daily operating costs for different types of model vending machine routes: Based on vending operations in Martinsburg, W. Va., 1956

Cost item	30 indoor machines	5 outdoor & 16 indoor machines	17 outdoor machines
	Dollars	Dollars	Dollars
Labor	8.77	8.82	8.75
Fringe labor benefits	.30	.30	.30
Truck	10.94	10.04	11.54
Machine cost:			
Depreciation	6.90	5.22	5.78
Maintenance	3.00	2.10	1.70
Total	9.90	7.32	7.48
Taxes and licenses	.54	.36	.29
Miscellaneous	5.00	5.00	5.00
Clerical	1.00	1.00	1.00
Total (less location rental)	1/ 36.45	1/ 32.84	1/ 34.36

1/ To obtain total costs, location rental amounting to 1 cent per unit must be added to the above costs. Thus, daily sales of 1,538 units would add location rental of $15.38 to the total costs shown in the table.

The initial cost of each machine at $658, and with an expected useful life of 8 years, gives a daily depreciation of 23 cents. Daily maintenance costs were estimated by the operator to be 10 cents per machine. For the 30 machines of this route, daily maintenance and depreciation costs total $9.90.

Yearly taxes and licenses were $6.50 per vending machine, making a daily cost of 54 cents for the route.

6/ Computed from data supplied by the dairy accounting firm of Edward B. McClain Company of Memphis, Tenn.

Check-in, counting receipts and other related activities required approximately 1 hour daily of clerical time. This is an additional daily cost of $1.00.

A miscellaneous daily charge of $5.00 is made to the route for such costs as refunds to customers, leaking containers, samples, or other purposes. Refunds for machine malfunction are made without question to maintain good customer relationships and is the most important of the miscellaneous costs.

Location rental is 10 percent of gross sales value. As vend price is 10 cents per unit, location rental is 1 cent per unit.

Break-even Sales Volume

Determination of the proportions in which different products were sold was necessary to compute the break-even point. 7/ On the routes studied, products were vended in a ratio of 9.3 units of chocolate milk, 3.3 units of homogenized milk and 1.0 unit of dairy orangeade. In some situations an item was sold in such small quantities that handling it was inconvenient. This was true of dairy orangeade at certain periods. The sales of chocolate milk and homogenized milk at those times were in the ratio of 2.4 units of chocolate milk for each unit of homogenized milk.

It is assumed that the products vended are charged to the vending operation at the wholesale selling price--7.0 cents per half-pint of chocolate milk, 6 cents per half-pint for homogenized milk, and 5.25 cents per half-pint of dairy orangeade.

With a selling price of 10 cents, the gross margin per unit available for the vending operation was 3 cents for chocolate milk, 4 cents for homogenized milk, and 4.75 cents for dairy orangeade.

On the basis of the proportions of products sold, as shown above, the average margin is 3.37 cents per unit of sale when chocolate milk, homogenized milk and dairy orangeade are vended, and 3.29 cents per unit of sale if only chocolate milk and homogenized milk are vended.

The break-even point for this model route requires daily sales of 1,052 units of chocolate milk, 373 units of homogenized milk and 113 units

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7/ The point where the volume of sales times the sales margin equals all selling costs.

of dairy orangeade. The total daily cost of vending these 1,538 units is $51.83 including location rental. A daily sales volume of 1,133 units of chocolate milk and 472 units of homogenized milk is needed to reach the break-even point if dairy orangeade is not vended. Thus, vending 2 products requires 67 more unit sales daily to break even than vending 3 products (fig. 1). 8/

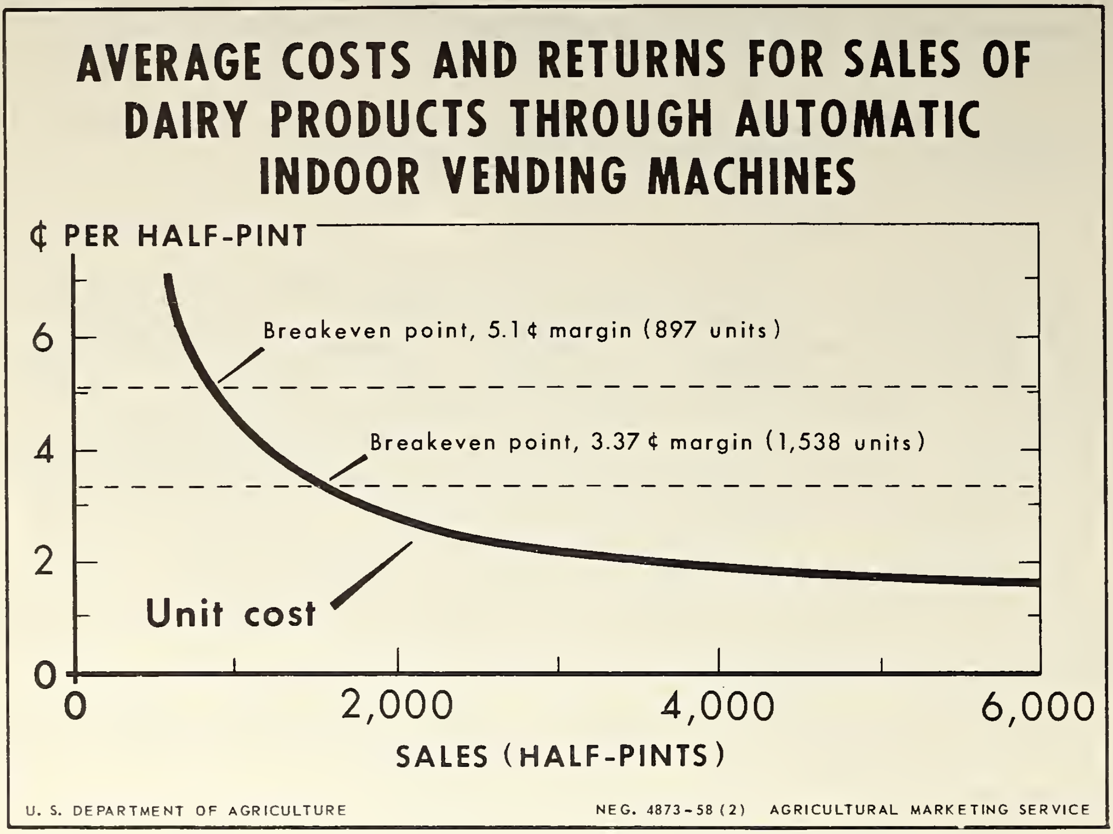

Figure 1

Sales cost per unit ranged from approximately twice to one-half of this margin with sales of 600 and 6,000 units, respectively (table 7). Daily sales of 600 units result in a loss of $21.90 if the break-even point requires

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8/ The break-even point is calculated from the daily route cost and net margin of products vended by the formula 9.3 (Mc) + 3.3 (Mw) + 1.0 (Mo)= route cost. M = sales net margin, c = chocolate milk, w = homogenized milk, and o = dairy orangeade. The sales ratio is 2.4 for chocolate milk to 1.0 homogenized milk when only these 2 products are vended.

sales of 1,538 units. Capacity sales volume of 6,000 units gives a net return of $102.77 and sales at half of capacity give a net return of $33.50. 9/

Table 7.--Daily average unit cost, unit weighted gross margin and net returns for a model route vending 3 dairy products

Sales volume 1/2-pint units	Per unit		Total net returns, 3.37¢ margin
	Cost 1/	Gross margin 2/	
	Cents	Cents	Dollars
600	7.02	3.37	-21.90
897	5.10	3.37	-15.52
1,000	4.64	3.37	-12.67
1,538 (break-even point)	3.37	3.37	0.0
2,000	2.85	3.37	10.41
3,000	2.25	3.37	33.50
4,000	1.95	3.37	56.58
5,000	1.78	3.37	79.65
6,000	1.66	3.37	102.77

1/ Assumes all costs fixed except loading, unloading and servicing and the 1 cent per unit location rental. It is also assumed that all labor is paid at $1.25 per hour, regardless of number of hours worked.

2/ Gross margin is weighted average margin of chocolate milk, homogenized milk, and dairy orangeade at the break-even point.

Costs per unit of sale decrease as sales increase, but at a decreasing rate. 10/ Since the gross margin per unit is constant, within the about volumes, net returns increase at a constant rate as unit sales increase (table 7).

If this model route operated at not above one-half of capacity, it would be possible to service it every-other-day instead of daily. 11/

9/ Labor cost is related to volume of sales. It is assumed here that any volume could be delivered in the time limit of the model route and labor cost becomes constant for the route.

10/ Assumes all costs fixed except 10 percent of sales price for location rental.

11/ This assumes that no single machine operates at more than $\frac{1}{2}$ of capacity under daily delivery.

Under every-other-day servicing, the daily cost of servicing the route would be reduced more than one-third.

The model route data shown in table 6 assume delivery of 1,538 units daily at a cost of $51.83 including $15.38 location rental, and a daily gross return of the same amount; thus either for a single day or for 2 days, they show no loss or gain.

On the basis of every-other-day service for the machines, 3,076 units would be delivered; gross return for every two days would be $103.66; the cost of every-other-day service $67.98, and the net return for the 2 days would be $35.68.

Use of Other Type Vending Machines

Sykes concluded from a study of milk vending in Vermont that, "No single milk-vending machine on the market is suitable for all locations" (9, page 9). He also noted that, "Factors such as total daily sales, peak periods of sales, type of people, requirements imposed by location management, and the need for extra servicing, all must be considered when choosing a vending machine for a given location." Spurlock and Hirsch found that many operators purchased manual vending machines to be used in locations having low sales volumes (8).

If vending machines had been selected for each of the model route locations on the basis of these criteria, some or all of them might have been manually operated rather than automatic.

Manually operated vending machines are more simply constructed than automatic ones and for this reason have lower depreciation and maintenance costs. Based on Sykes' data, the average cost of two different sizes of manually operated milk vending machines, vending in paper cartons, was $309.06, which is approximately one-half the cost of an automatic machine as determined in this study (9, page 4, table 1). Therefore, the substitution of one or more manually operated machines for the automatic ones used on the model route would have reduced these particular costs proportional to the number substituted.

Assuming that manually operated vending machines had been selected for all of the model route locations, daily depreciation costs of each machine would be reduced from 23 to 11.5 cents. It may also be assumed that daily machine maintenance costs would also be reduced from 10 to 5 cents due to the differences in mechanical complexity of the 2 types of machines. This would be a daily route depreciation and maintenance cost of $4.95 as compared with the $9.90 cost if only automatic machines are used. With no change in other operating costs, daily route costs would be reduced from $36.45 to $31.50.

The break-even sales volume would then be 1,329 units. Sales would include 909 units of chocolate milk, 322 units of homogenized milk and 98 units of dairy orangeade. Thus the substitution of manually-operated machines for automatic ones reduces the daily break-even sales volume 209 units.

Comparison of West Virginia and South Carolina Route Costs

Comparing operating costs of the model route with those of 2 similar routes in South Carolina shows the commission paid for location to be the most important of route costs (table 8). The order of relative importance of other cost factors varies between routes, but are in general: Salary, truck, depreciation, repairs, interest, and taxes.

As commission paid for location is of such great relative importance and as average sales vary between routes, it and "other costs" were computed for each route on a per unit basis (table 9). This shows the 22-vendor route to have the largest commission cost and the lowest "other cost." The 38-vendor route has the lowest commission cost. Commission costs for the model route are between those of the 22-and 38-vendor routes, but "other costs" are the highest per unit of sale.

Both costs per unit of sales and costs per vending machine decline as the number of machines serviced on a route increases (tables 9 and 10). The cost of servicing one machine as indicated is unrealistic, as it would be serviced from an established route, either wholesale or retail, and would therefore have only a marginal cost. It may also be assumed that average machine cost would increase at some point if it became necessary to pay the routeman for overtime or to employ additional labor and equipment.

Combined Outdoor and Indoor Vending by a Dairy

Route Information

This model route is assumed to service 5 outdoor and 16 indoor milk vending machines. Outdoor machines are located at or adjacent to filling stations; indoor machines in office buildings, filling stations, garages, manufacturing plants, and in other similar industrial locations.

The outdoor machines vend homogenized milk in quart, and chocolate milk in one-half-pint paper containers. The indoor machines vend homogenized milk and chocolate milk in one-half-pint paper containers.

The route is 62 miles in length and requires approximately 7 hours to service.

Table 8.--Total weekly operating costs (exclusive of milk cost) on 3 milk vending routes

Cost item	Milk dealer with: 22 vending machines 1/		Model route with 30 vending machines		Specialized vendor with 38 vending machines 1/	
	Dollars	Percent	Dollars	Percent	Dollars	Percent
Commission paid for location	140.53	45.6	91.38	31.4	102.33	29.5
Salary	60.00	19.5	54.42	18.7	78.75	22.7
Truck	44.70	14.5	65.64	22.6	34.51	9.9
Depreciation	27.50	8.9	39.60	13.6	47.50	13.7
Taxes	17.10	5.5	3.24	1.1	23.35	6.7
Interest on investment	6.87	2.2	2/ 12.66	4.4	12.84	3.7
Repairs	5.06	1.6	18.00	6.2	24.33	7.0
Accounting	4.84	1.6	6.00	2.0	8.43	2.4
Overhead & miscellaneous	1.98	.6	30.00	---	3.36	1.0
Route supervisor	---	---	---	---	11.86	3.4
Total	308.58	100.0	320.94	100.0	347.26	100.0
Average cost/vendor	14.03	---	10.70	---	9.14	---
Average sales/vendor (units)	365	---	305	---	272	---

1/ Data were taken from (2), pages 32-33. These are cost data for actual routes.

2/ Interest on investment calculated to make the comparison of costs more complete.

Operating Costs

The routeman's labor cost is computed at $1.25 per hour. Delivery and driving comprise 83 percent of the total daily time required at a cost of $4.03 and $3.36, respectively. Total daily labor cost for the routeman is $8.82, not including a 30-cent daily cost of fringe benefits (table 11).

Daily truck cost is $10.04, based on a charge of 16.2 cents per mile and a route length of 62 miles (page 12).

Table 9.--Sales costs per unit on 3 milk vending routes

	22 vending machines	30 vending machines	38 vending machines
	Dollars	Dollars	Dollars
Commission	.0175	.0100	.0099
Other costs	.0209	.0251	.0237
Total costs	.0384	.0351	.0336

Table 10.--Daily operating costs for indoor milk vending routes with various numbers of machines 1/

Cost item	Number of vending machines per route-- 1	5	10	15	20	25	30
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Interest	.07	.35	.70	1.05	1.40	1.75	2.10
Depreciation	.22	1.10	2.20	3.30	4.40	5.50	6.60
Taxes and licenses	.02	.09	.18	.27	.36	.45	.54
Labor	1.55	1.75	3.20	4.63	6.08	7.53	9.05
Miscellaneous	1.00	1.00	2.00	3.00	3.75	4.50	5.00
Office	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Truck 2/	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Truck/mile (.088) 2/	.40	1.18	2.18	3.17	4.15	5.14	6.14
Location rental (.01) 3/	4.21	5.31	7.62	9.80	12.11	14.28	16.32
Vending machine maintenance (.002 per unit) 4/	.84	1.06	1.52	1.96	2.42	2.86	3.26
Total costs	14.31	17.84	25.60	33.18	40.67	48.01	55.02
Average cost/vending machine	14.31	3.56	2.56	2.21	2.03	1.92	1.84

1/ Sales volume at break-even point.
2/ Based on data obtained from the Edward B. McClain Co., Memphis, Tenn.
3/ Fixed per unit cost of location rental.
4/ Based on observed route operator's estimate of maintenance costs.

Table 11.--Daily labor requirements and costs for a model milk vending route of 5 outdoor and 16 indoor machines: Based on vending operations in Martinsburg, W. Va., 1956

Operation	Average percent of total required time	Average time required		Allocated labor cost ($1.25/hour)
	Percent	Minutes	Seconds	Dollars
Load	2	7	33	.16
Ice	1/	2	06	.04
Drive	38	160	01	3.36
Delivery				
Enter	7	30	40	.64
Service	35	147	25	3.10
Return	4	13	51	.29
Total	46	191	56	4.03
Personal	9	36	58	.78
Unload	2	7	34	.16
Check-in	3	13	52	.29
Total	100	420	00	8.82

1/ Less than 1 percent.

The 21 vending machines serviced on this route represent an investment of $15,248.00. Each vending machine is estimated to have a useful life of 8 years. Daily depreciation on indoor vending machines is 22 cents and on outdoor vending machines, 34 cents. Total daily depreciation is $5.22. The operator estimates the daily maintenance cost to be 10 cents per machine or $2.10 for the model route (table 6).

Taxes and licenses at $6.50 per year, per machine, is a 36-cent daily route cost.

Approximately 1 hour of a clerk's time is required each day to check the routeman's book, count receipts and prepare statements. At a rate of $1.00 per hour this adds $1.00 to route cost.

A $5.00 miscellaneous cost is charged to the route to cover such factors as refunds for machine malfunction, "samples," leaky containers and other incidental costs.

The total daily cost of route operation, less the unit sales cost is $32.84 (table 6).

Break-even Sales Volume

The ratio of sales, based on observed routes, was 1 quart of homogenized milk to 3 half-pints of homogenized milk and 11 half-pints of chocolate milk. The gross margin or vend price less wholesale price was 3.75 cents for homogenized milk in quarts, 4 cents for homogenized milk in half-pints and 3 cents for chocolate milk in half-pints. Net margin was 1 cent less due to cost of location rental.

Break-even sales volume for this route is 97 quarts and 291 half-pints of homogenized milk, and 1,067 half-pints of chocolate milk. This amounts to total sales of 1,455 units and increases total daily route cost to $47.39. 12/

Outdoor Milk Vending by a Dairy

Route Information

This model outdoor milk vending route 13/ requires 7 hours daily to service 17 vending machines. These machines vend homogenized milk in quart-size paper containers and each is located at or adjacent to a filling station. Driving speed averages 28.5 miles per hour for the 71 $\frac{1}{4}$ miles driven on this route.

Labor Requirements

Driving time on the model outdoor milk vending route is 2 hours 50 minutes or 10 minutes for each of the 17 machines. This represents 40 percent of route time and has the greatest relative importance of all route labor operations (table 12). Second in importance is "delivery" which requires 2 $\frac{1}{2}$ hours or 36 percent of route time. Personal time used is 53 minutes or 13 percent of route time. "Loading, icing, and unloading" require 28 minutes or 7 percent of route time, while "check-in" time takes 17 minutes or 4 percent of route time.

Operating Costs

Daily labor cost of this model route, having a 7-hour daily labor requirement, is computed to be $8.75, not including the $.30 estimated cost of fringe benefits (table 6). 14/ Daily truck cost is $11.54 for

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12/ See page 14, footnote 8, for formula used to determine unit sales at break-even point.

13/ Total labor requirements for this model route are based on observations made of the actual route servicing both indoor and outdoor milk vending machines.

14/ Total labor requirement for this route is assumed to be the same as for other type vending routes.

Table 12.--Daily labor requirements, their relative importance and costs for a model milk vending route of 17 outdoor machines: Based on vending operations in Martinsburg, W. Va., 1956

Labor operation	Time requirement		Labor cost at $1.25 an hour
	Minutes	Percent	Dollars
Load, ice, unload	28	7	.58
Drive	170	40	3.55
Deliver	152	36	3.17
Personal	3	13	1.10
Check-in	17	4	.35
Total	420	100	8.75

the 71 $\frac{1}{4}$ miles driven or 16.2 cents per mile. Machine costs are $7.48 daily with $5.78 of this amount representing depreciation on the $17,000 invested in vending machines and $1.70 for the estimated daily cost of maintenance. Taxes and licenses add another $.29 to the daily cost with a charge of $5.00 made to cover miscellaneous costs. Clerical help, estimated to be 1 hour daily, adds $1.00 to total route cost. Total cost, less a 1-cent per unit location rental cost was $34.36 (table 6).

Break-even Sales Volume

The break-even sales volume for this model route is 1,250 quarts daily, with a gross sales margin between wholesale and vend price of 3.75 cents per unit. Each vending machine on this route must have daily sales of 75 quarts to break even.

Comparison of Route Costs with Results of Other Studies

A comparison can be made of the daily operating costs of the outdoor milk vending machine route in Martinsburg, West Virginia, with costs for a similar route in Colorado. 15/ Although the operation of these two routes is similar, certain differences such as container size vended,

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15/ Costs and other factors for the Colorado route were computed from material presented in the unpublished M.S. thesis: "A Cost Analysis of a Dairy Marketing Firm" (5). The research in Colorado was done under a cooperative agreement between AMS and the Colorado Agricultural Experiment Station.

number of vending machines, and route length should be noted 16/ (table 13).

Table 13.--Comparison of selected factors of 2 similar outdoor milk vending machine routes

Item	Martinsburg, West Virginia	Colorado
Container size.................	Quart	½ gallon
Number of machines.............	17	8
Route length...................	71 ¼ miles	80 miles
Selling margin (vend - wholesale price)......................	3.75 cents/unit	5 cents/unit
Location rental................	1 cent/unit	.5 cent/unit
Truck cost/mile................	16.2 cents	16.3 cents

The largest of all cost items for both outdoor milk vending routes is machine cost 17/ (table 14). This cost is mainly depreciation, which is high due to the large initial investment in each machine and its relatively short useful life. The second and third largest items of cost in the West Virginia study are location rental and truck cost. In the Colorade study, the order of these costs is reversed. Labor is the fourth largest cost for both routes. Other costs of operation for each route are relatively insignificant in relation to total cost but together represent 10.3 percent for the West Virginia route and 16.2 percent for the Colorado route.

The yearly sales volume break-even point for these 2 routes is 274,998 quarts for the West Virginia route and 199,697 ½-gallons in Colorado. Average daily sales for the routes were 753 quarts 18/ and 547 ½-gallons, or 44 quarts and 68 ½-gallons, per vending machine.

Due to the differences in costs and margins, the Colorado route has a 3 percent higher total cost and requires 11 percent more units to be sold to break even than the West Virginia route. The Colorado route also distributes 2.2 times the volume of milk, at its break-even point, because

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16/ Similarity of labor and other activities makes this comparison feasible.

17/ With every-other-day delivery.

18/ It will be noted that the break-even sales volume is reduced from 1,145 quart sales on daily delivery to 691 quart sales on every-other-day delivery.

of its use of $\frac{1}{2}$-gallon containers and larger necessary sales volume to break even.

Table 14.--Comparison of yearly cost of servicing outdoor milk vending machines on 2 routes serviced every-other-day

Cost item	Martinsburg, West, Virginia	Colorado
	Dollars	Dollars
Labor	$ 1,365.00	$ 1,357.12
Truck	1,800.24	2,033.20
Machine cost:		
Depreciation	2,730.20	3,742.48
Maintenance	620.50	1/ 141.78
Total	$ 3,350.70	$ 3,884.26
Taxes and licenses	110.50	252.32
Miscellaneous	780.00	1,159.44
Clerical	156.00	300.00
Location rental	2,749.98	2/ 998.49
Total cost	$10,312.42	$ 9,984.85

1/ $ 0.00071 per unit.
2/ $ 0.005 per unit.

COSTS OF HOME DELIVERY

Route Organization and Labor Utilization in Martinsburg, W. Va.

Route Information

Home delivery was observed on 1 route in April and 3 routes each in July and October 1956. Homes throughout the city and in adjacent residential areas received delivery on an every-other-day schedule. Deliveries were not made on Sundays.

Each routeman was assigned 2 routes and serviced each on alternate days. Five of the routes observed were serviced by 1 man and 2 were serviced by 2 men each.

A full line of dairy products was distributed with fluid products packaged in $\frac{1}{2}$-pint or quart containers available either in paper or glass, and pint and $\frac{1}{2}$-gallon containers in paper only.

Delivery to homes was made in the early morning hours with 1 route starting as early as 2:00 a.m. Delivery was made at this time of day to avoid traffic, reduce chances of product spoilage and supply customers before the retail stores opened. Products were placed in aluminum-covered, insulated boxes supplied by the servicing dairy to give the product additional protection.

Home delivery routes averaged 15.1 miles in length and served 6 customers per mile. Serving customers in different parts of town and in residential areas adjacent to town on the same routes, reduced the number of customers served per mile and caused mileage per route to be high.

Each routeman was responsible for collecting from the customers he served. He was also encouraged to solicit new customers and received a small sum for each one obtained. These two activities were not observed because of the variation in methods used and time expended by different routemen.

Daily sales averaged 370 units, a unit being any single container irrespective of its size or content (table 15). Fluid product units represented 98.1 percent of the units delivered, of which 63.9 percent were in quart-size containers. Glass containers were favored for home delivery as approximately 54 percent of the fluid products were delivered in this type container to 44 percent in paper. 19/ Manufactured dairy products were delivered in relatively small quantities and were handled as a marginal sales item and as a customer convenience.

Labor Requirements

Driving required on home delivery routes averaged approximately 1.5 hours or 46 percent of route time. Thus driving was the most important labor requirement (table 16). Average speed was only 10 miles per hour due to the "stop and go" type of driving required.

The second most important labor requirement in respect to amount of time required was "delivery" which averaged 48.2 minutes or 24 percent of route time. 20/ This was approximately $\frac{1}{2}$-minute for each of the 91

19/ Two percent of units were nonfluid products.

20/ Timing delivery on 1-man routes began as the routeman left the delivery vehicle and ended with his return. Delivery on 2-man routes was timed similarly if only one man made deliveries. If both delivered, time was taken from the departure of the first man until the second man returned and the stop considered as one with multiple deliveries. This imparts a downward bias to delivery time required but the effect has been reduced by averaging the requirements of all routes.

customers per route. Delivery time per customer was influenced to some degree by the driver's ability to serve more than one customer before returning to the delivery vehicle (table 17).

Table 15.--Average units delivered on 7 home delivery routes, by product container type, and size, Martinsburg, W. Va., 1956 1/

Product	Size	Paper		Glass		Other	
		Units	Percent	Units	Percent	Units	Percent
Homogenized milk	½ gallon	13	3.5	---	---	---	---
	Quart	55	14.9	99	26.7	---	---
	½ pint	60	16.2	2	.5	---	---
Grade A	Quart	13	3.5	98	26.5	---	---
Half and half, coffee cream	½ pint	3	.8	1	.3	---	---
Buttermilk	Quart	2	.5	---	---	---	---
Chocolate milk	Quart	5	1.4	---	---	---	---
	½ pint	4	1.1	---	---	---	---
Skim milk	Quart	6	1.6	1	.3	---	---
Orangeade	Quart	1	.3	---	---	---	---
Cottage cheese	Carton	---	---	---	---	4	1.1
Butter	Pound	---	---	---	---	2	.5
Reddi-Wip	Can	---	---	---	---	1	.3
Total		162	43.8	201	54.3	7	1.9
Total (all units)		370	100.0	---	---	---	---

1/ Information was obtained for 1 route in April and 3 routes each in July and October 1956.

Loading, icing, and unloading averaged 25 minutes or 12 percent of route time. Loading was the most important of these operations requiring 18 minutes. Routemen arranged their load so that each product was readily accessible, reducing to a minimum the necessity for rearranging the load on the route. Loads on some routes were iced with unbagged flake ice, others with cake ice and 1 route was equipped with a mechanically refrigerated truck. Icing the load was, in general, accomplished as a part of loading. Unloading was rapid, since several cases usually were handled at 1 time. Returned products were at a minimum on home delivery routes as requirements were relatively fixed from one delivery to the next.

Personal time used was 12.5 minutes, which was 7 percent of route time. Personal use of time was relatively unimportant due to the time of day during which the route was serviced.

Table 16.--Operations included in servicing a home delivery milk route, and their relative importance, average of 7 routes, Martinsburg, W. Va., 1956 1/

Item	Average time requirements		Average percent of total route time 2/
	Minutes	Seconds	Percent
Load	17	35	9
Ice	0	56	3/
Drive	92	46	46
Delivery	48	13	24
Unload	6	29	3
Check-in	23	8	11
Personal	12	34	7
Total	201	41	100

1/ Table 15, footnote 1.
2/ Rounded from one decimal.
3/ Less than 1 percent.

Table 17.--Number of customers served and number of times 2 or 3 customers were served: 7 home delivery routes, Martinsburg, W. Va., 1956 1/

Customers	Total	Average of 7 routes
Total number	636	91
Times 2 customers were served	78	11
Times 3 customers were served	11	1.6

1/ Table 15, footnote 1

Route check-in varied in detail among dairies, but in general consisted of crediting each customer's account with deliveries made and accounting for distribution of products. Check-in averaged 23 minutes or 11 percent of route time.

Comparison of Labor Requirements for Different Areas

The relative importance of labor requirements for retail delivery differs among various published reports on the subject. The variation is particularly noticeable for driving and delivery, which range from 23 percent to more than 45 percent of route time (table 18). Together these time requirements represent from one-half to approximately three-quarters of route time. Delivery was more important than driving in all studies except the present one, for Martinsburg, where the relationship is reversed. It should be pointed out that the total labor requirement of the Martinsburg routes is approximately one-half that of the routes to which it is compared (table 18). This is expected in view of the relative population numbers of these markets. Smaller markets allow each family more living space. Delivery trucks may also be driven closer to the point of delivery in smaller markets. For these two reasons, the driving requirement is greater and the labor requirement less for small markets than large ones.

Table 18.--Operations included in servicing home delivery milk routes and their relative importance as reported for selected markets 1/

Operation performed	Indiana 2/		Ithaca, N. Y. 3/		New Haven, Conn. 3/		Cinncinnati, Ohio 4/		Martinsburg, W. Va. 5/	
	Min.	Pct.	Min.	Pct.	Min.	Pct.	Min.	Pct.	Min.	Pct.
Load & unload	17.0	3.8	66.0	14.0	61.0	13.0	41.3	8.6	24.1	11.9
Ice load	10.8	1.1	---	---	---	---	---	---	0.9	0.5
Drive	116.1	26.0	135.0	28.0	138.0	30.0	115.4	23.8	92.8	45.8
Delivery	136.6	29.5	190.0	39.0	141.0	31.0	244.6	50.6	48.2	23.9
Check-in	43.8	7.0	51.0	11.0	37.0	8.0	32.0	6.6	23.1	11.4
Personal	28.0	6.2	---	---	---	---	50.4	10.4	12.6	6.3
Total	470.4	100.8	481.0	100.0	457.0	100.0	483.1	100.0	201.7	100.0

1/ Data abstracted for comparative use and do not total.
2/ Data abstracted from (6), page 9.
3/ Data abstracted from (3), page 19.
4/ Data computed from (1), pages 50-53.
5/ Based on observed routes.

Model Route Organization and Labor Utilization

Route Information

This model home delivery route, requiring 1 man 7 hours daily to service, is constructed from the average requirements of observed routes. The route is 31.3 miles in length and deliveries are made to 188 customers who buy an average of 770 units of dairy products every-other-day. This is an average delivery of 4 units per customer.

Cost Allocation

Labor cost for servicing the model home delivery route is computed at a rate of $1.25 per hour making the total daily labor cost $8.75. [21] This cost consists of $4.02 for "driving," $2.08 for "delivery," $1.00 for check-in and $1.65 for other labor activities (table 19). There is also an additional daily cost of 30 cents to management for employee fringe benefits that was not allocated to labor activities.

Table 19.--Daily labor requirements and costs for a model home delivery route: Based on home delivery operations in Martinsburg, W. Va., 1956

Item	Percent of total time [1] required	Computed time model route	Cost allocation $1.25/hour
	Percent	Minutes	Dollars
Load	9	36.5	.76
Ice	[2]	2.1	.04
Drive	46	192.4	4.01
Delivery	24	100.0	2.08
Unload	3	13.4	.28
Check-in	11	47.9	1.00
Personal	7	27.7	.58
Total	100	420.0	8.75

[1] Rounded from one decimal.
[2] Less than 1.0 percent.

Truck operating cost is computed at a rate of 16.2 cents per mile for a daily cost of $5.07 for this model route, which covers 31.3 miles. [22]

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[21] See page 10 for basis of labor cost.
[22] See page 12 for source of truck cost.

Clerical time necessary to maintain route records and to check-in routes is estimated to amount to approximately 1 hour daily per route and at a rate of $1.00 per hour, adds this amount to the daily route cost.

Total daily cost for this model route was $15.12 (table 20).

Table 20.--Cost rates and daily costs for a model home delivery milk route: Based on home delivery operations in Martinsburg, W. Va., 1956

Cost item	Cost rate	Total daily cost
	Dollars	Dollars
Fringe labor benefits	.30 daily	$ 0.30
Labor	1.25 per hour	8.75
Truck	.162 per mile	5.07
Clerical	1.00 per hour	1.00
Total		$15.12

Wholesale-Retail Price Spread and Gross Returns

The spread between the wholesale and retail selling prices was determined for each product in order to compute the route return over the wholesale cost (table 21). Spreads ranged from a minimum of 2 3/4 cents per unit for milk in glass containers to 10 cents for a unit of Reddi-Wip. The value of this spread for all of the 770 units delivered was computed to be $25.02 and the total daily receipts, $173.04.

Comparing the total daily delivery cost in table 20 with the total daily spread in table 21 shows the model home delivery route to have a return of $9.90 over delivery and wholesale product cost. Other computations show that delivery cost is 9 percent of retail receipts and amounts to an average of 8 cents per customer.

Table 21.--Units delivered daily, retail price, wholesale-retail price spread, gross margins and gross receipts by product and container for the model home delivery milk route

Product	Size	Units delivered			Retail price			Wholesale-retail price spread		Gross margin (Units delivered times price spread)			Gross receipts		
		Paper	Glass	Other	Paper	Glass	Other	Paper	Glass	Paper	Glass	Other	Paper	Glass	Other
						Dollars		Dollars			Dollars			Dollars	
Homogenized milk	½ gallon	27	---	---	.46	---	---	.05	---	1.35	---	---	12.42	---	---
	Quart	116	206	---	.24	.23	---	.03	.0275	3.48	5.66	---	27.84	47.38	---
	½ pint	125	4	---	.10	.10	---	.04	.04	5.00	.16	---	12.50	4.40	---
Grade A milk	Quart	27	204	---	.23	.22	---	.03	.0275	.81	5.61	---	6.21	48.88	---
Half and half	½ pint	5	2	---	38	.38	---	.06	.06	.30	.12	---	1.90	.76	---
Buttermilk	Quart	4	---	---	.18	---	---	.03	---	.12	---	---	.72	---	---
Chocolate milk	Quart	11	---	---	.25	---	---	.03	---	.33	---	---	2.75	---	---
	½ pint	8	---	---	.10	---	---	.03	---	.24	---	---	.80	---	---
Skim milk	Quart	12	2	---	.14	---	---	.02	.02	.24	.04	---	1.68	.28	---
Orangeade	Quart	2	---	---	.20	---	---	.02	---	.04	---	---	.40	---	---
Cottage cheese	Carton	---	---	9	.24	---	.24	.04	---	.36	---	.36	2.16	---	2.16
Butter	Pound	---	---	4	.74	---	.74	.05	---	.20	---	.20	2.96	---	2.96
Reddi-Wip	Can	---	---	2	.47	---	.47	.10	---	.20	---	.20	.94	---	.94
Total		337	418	15						12.67	11.59	.76	73.28	93.70	6.06
Total (all sales)				770						25.02			173.04		

COSTS OF WHOLESALE DELIVERY

Route Organization and Labor Utilization in Martinsburg, W. Va.

Route Information

Dairy products were delivered to restaurants or lunch counters, retail grocery stores, institutions, and other retail outlets daily, except Sunday. Delivery operations were observed on 1 route in January, 2 routes in April and 3 routes each in July and October 1956. At least 2 routes were observed for each of the 3 local dairies. Seven of these 9 routes were serviced by 1 man each and 2 by 2 men each.

Many wholesale customers preferred delivery as soon as possible after they opened for business. Customer service of this type prevented the most efficient organization of delivery routes but was given to hold customers.

Small retail grocery stores and restaurants usually purchased from only 1 dairy while the large grocery stores obtained deliveries from all dairies. Institutions were supplied under contracts obtained by bidding.

Each dairy distributed a complete line of fluid milk and fluid milk products, cream, and manufactured dairy products and dairy specialities. Fluid products were distributed in both paper and glass ½-pint and quart containers and paper pint and ½-gallon containers. Homogenized milk was available to restaurants in 5-gallon metal dispensing cans (table 22).

Table 22.--Container size and type and dairy products distributed by observed dairies, Martinsburg, W. Va., 1956

Container size	Dairy I			Dairy II			Dairy III		
	Paper	Glass	Other	Paper	Glass	Other	Paper	Glass	Other
5-gallon			x						x
Gallon					x				
½-gallon	x			x			x		
Quart	x	x		x	x		x	x	
Pint	x						x		
½-pint	x	x		x	x		x	x	
Box (cottage Cheese)	x			x			x		
Pound (butter)	x			x			x		
Can (Reddi-Wip)			x						x

Wholesale routes averaged 30 customers each, including 17 retail grocery stores, 10 restaurants or lunch counters, 2 institutions, and 1 other type of retail outlet. 23/

Daily deliveries averaged 719 units, each unit representing 1 item delivered irrespective of product or package size (table 23). Fluid

Table 23.--Average units delivered daily on 9 wholesale milk routes by product, container type, and size, Martinsburg, W. Va., 1956 1/

Product	Size	Paper		Glass		Other	
		Units	Percent	Units	Percent	Units	Percent
Homogenized milk.....	5-gallon	---	---	---	---	1	.1
	½-gallon	43	6.0	---	---	---	---
	Quart	141	19.6	28	3.9	---	---
	Pint	1	.1	---	---	---	---
	½ pint	269	37.4	8	1.1	---	---
Grade A milk.........	Quart	46	6.4	43	6.0	---	---
	½ pint	---	---	5	.7	---	---
Half-and-half, coffee cream..............	Quart	10	1.4	6	.8	---	---
	½ pint	4	.6	1	.1	---	---
Whipping cream.......	½ pint	5	.7	1	.1	---	---
Chocolate milk.......	Quart	9	1.2	---	---	---	---
	Pint	2	.3	---	---	---	---
	½ pint	32	4.5	8	1.1	---	---
Orangeade............	Quart	2	.3	1	.1	---	---
	½ pint	2	.3	3	.4	---	---
Buttermilk...........	Quart	5	.7	2	.3	---	---
Skim milk............	Quart	3	.4	---	---	---	---
Cottage cheese.......	Carton	---	---	---	---	32	4.5
Butter...............	Pound	---	---	---	---	2	.3
Reddi-Wip............	Can	---	---	---	---	4	.6
Total..........		574	79.9	106	14.6	39	5.4
Total (all units)				719			

1/ These 9 routes included one observed in January, 2 in April and 3 each in July and October 1956.

23/ Some filling stations sold milk as a service to customers.

products comprised 94.5 percent or 680 of these 719 units with 93.2 percent or 634 units packaged in either quart or ½-pint containers. Eighty-four and four-tenths percent of all fluid products was sold in paper containers.

Customers usually made payment at the time of delivery. Institutions, however, were serviced under contracts which specified the terms of payment. Large chainstores paid monthly.

Wholesale routes averaged 17.0 miles in length and serviced approximately 2 customers per mile of driving. The average number of customers per mile driven was low due to the amount of backtracking necessary to serve customers at the time they desired.

Labor Requirements

Driving required 22.9 minutes or 21 percent of route time, making it second in relative importance among labor time requirements. Driving time was not influenced by traffic conditions as many customers, particularly small retail grocery stores, were located in residential areas and the restaurants were serviced before traffic became heavy (table 24).

Delivery, which required more route time than other labor activities, was approximately 3 ¼ hours or 50 percent of route time. Delivery time included time spent to make trips from the delivery truck into the store and return to obtain an order or to deliver the product, arranging items in display cases, sorting empty bottles, having the order checked, and receiving payment.

An order trip was not necessary at every stop as institutions usually had a fixed order and in some other cases the routeman anticipated the order. Trips to obtain an order were made to an average of 24 of the 30 customers per route. Some customers left the order size to the routeman's discretion; others made their own determination. Labor time required to obtain orders averaged approximately 1 hour or 16 percent of route time.

Products were delivered to 25 of the 30 customers. Delivery required 2 ¼ hours and was 34 percent of route time. Each trip the routeman made from the truck into the customer's establishment and return was timed separately. The first delivery trips made to the 25 customers receiving delivery required 84.5 minutes representing 22 percent of route time.

Nine customers required 2 delivery trips, adding 33.5 minutes and 8 percent to route time. Three of these customers required a third trip, adding 15 minutes and 4 percent to the route time.

Table 24.--Operations included in servicing a wholesale milk route and their relative importance, average of 9 routes, Martinsburg, W. Va., 1956 1/

Labor activity	Average time requirements 9 observations		Average percent of total route time 2/
	Minutes	Seconds	Percent
Load	17	59	5
Ice	1	4	3/
Drive	82	52	21
Order trip	61	48	16
Delivery			
Trip I	84	30	22
Trip II	33	31	8
Trip III	15	2	4
Total	133	03	34
Waiting	16	18	4
Personal	34	45	9
Unload	14	59	4
Check-in	29	11	7
Total	391	59	100

1/ Table 23, footnote 1.
2/ Rounded from one decimal.
3/ Less than 1 percent.

Loading, icing and unloading required approximately 34 minutes or 9 percent of route time. Loading and icing were usually done simultaneously and used 19 minutes or 5 percent of route time. Unloading took 15 minutes or 4 percent of route time.

Some of the routeman's time was spent waiting for a customer to open for business. This required approximately 17 minutes, or 4 percent of route time. Waiting was caused by being ahead of schedule or a customer opening later than usual.

Personal services required 34 minutes or 9 percent of route time. This time was generally spent for "coffee breaks" in restaurants they serviced. Coffee breaks might be regarded as part of the routeman's sales effort or a means of improving customer relations.

Check-in time averaged 29.2 minutes or 7 percent of route time. Check-in was reduced to a minimum as a bill had been prepared for each customer at the time of delivery. This simplified the accounting procedure into making the deliveries, returns and cash receipts balance.

Total daily route time averaged 6 hours 22 minutes. This does not include any time the routeman used in soliciting new customers or collecting an occasional overdue bill.

Comparisons of Labor Requirements in Selected Markets

Labor time requirements have been reported in studies made in various locations (table 25). The way labor is classified varies among these studies. However, the relative importance of the various labor activities is reasonably consistent.

Model Route Organization and Operating Costs

Route Information

The average total daily time requirement of the observed routes was such that one man was employed full time. The average requirements on the routes observed are used directly in constructing the model route. The major costs of this wholesale route include those for labor, truck and clerical help but exclude product cost.

Operating Costs

The method used to determine the wholesale routeman's wages varies between dairies, but in each case the routeman is guaranteed a minimum wage. [24] Based on the minimum wage and a 40-hour workweek, the hourly wage rate is estimated to be $1.25. Total daily labor cost at this rate for the 6.5 hours worked is $8.14 (table 26). The labor cost of driving

Table 26.--Costs rates and daily cost for a model wholesale delivery milk route: Based on wholesale delivery in Martinsburg, W. Va., 1956

Cost item	Cost rate	Daily cost
Labor	$1.25 per hour	$ 8.14
Fringe labor benefits	1.80 per week (6-day week)	.30
Truck	.162 per mile	2.75
Clerical	1.00 per hour	1.00
Total		$12.19

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[24] A small fixed wage plus 5 percent commission on sales was used to determine wages by the observed dairies.

Table 25.--Operations included in servicing wholesale delivery milk routes, and their relative importance, as reported for selected markets

Comparison item	Area									
	Indiana 1/		Martinsburg, W. Va.		New Haven, Conn. 2/		Hartford, Conn. 2/		Milwaukee, Wis. 3/	
	Min.	Pct.	Min.	Pct.	Min.	Pct.	Min.	Pct.	Min.	Pct.
Load and unload	26.9	6.3	33.0	8.4	38.0	7.1	50.0	10.9	45.5	8.3
Ice load	6.1	1.4	1.1	.3	---	---	---	---	2.2	.4
Drive	101.9	24.0	82.9	21.1	167.0	31.0	122.0	26.6	79.1	14.4
Wait for store to open	---	---	16.3	4.2	---	---	---	---	---	---
Delivery	234.3	55.2	194.8	49.7	212.0	39.3	136.0	29.7	352.2	64.0
Order trip	32.6	7.7	61.8	15.8	---	---	---	---	62.0	11.3
Delivery trip I	---	---	84.5	21.6	49.0	9.1	45.0	9.8	290.2	52.7
Delivery trip II	---	---	33.5	8.5	---	---	---	---	---	---
Delivery trip III	---	---	15.0	3.8	---	---	---	---	---	---
Miscellaneous, including personal	29.5	7.0	34.8	8.9	122.0	22.6	150.0	32.8	39.8	7.2
Check-in	25.9	6.1	29.2	7.4	---	---	---	---	31.7	5.7
Total	424.6	100.0	392.1	100.0	539.0	100.0	458.0	100.0	550.5	100.0

1/ (6, p. 25). Omits some time-requirements.
2/ (3, p. 28).
3/ (4, tables 6, 19, and 22).

and of making delivery represents 70.8 percent of this total cost or $5.77. The remaining cost is divided among all other labor activities.

Daily truck cost is computed to be $2.75 at a rate of 16.2 cents per mile for this 17.0 mile route (page 15).

Approximately 1 hour of clerical assistance is required daily to maintain route records. Clerical personnel are available at a rate of $1.00 per hour, adding $1.00 to daily route costs.

Total daily route costs for these major costs items at the given rates are $12.19 (table 26).

Daily Route Returns

Daily gross returns to the wholesale milk route for sales, based on average sales of observed routes, are $122.38 (table 27). 25/ As the cost of delivering these products is $12.19 daily, $110.19 remains to cover all other expenses and profit. Tables 26 and 27 show that delivery cost is approximately 10 percent of daily gross returns, and that each stop has a delivery cost of approximately 40 cents.

COMPARISONS OF ROUTE COSTS

Comparisons of operating costs of the different milk distribution methods included in this study are made on the basis of (1) cost per dollar of sale and (2) cost per unit of product delivered. Thus operating costs are related to both route returns and sales volume. The individual product costs to the plant operators are not available and therefore the computation and comparison of route net returns is not possible.

The operating costs per dollar of sales are 10 cents for the wholesale delivery route, or 1 cent greater than similar costs of the every-other-day home delivery route (table 28). However, wholesale route costs are only half those of daily delivery to homes. 26/ The costs per dollar of sale

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25/ The costs of different products, by container size, are not available as smaller plants considered it impractical to maintain such detailed records. For this reason no attempt was made to measure net returns to the route.

26/ This assumes that delivery volume for a daily route is half of the volume for the every-other-day route without any change from the every-other-day route operation, costs, or number of stops. The results of other cost studies report the costs of home delivery to be a function of number of stops rather than the volume of deliveries per stop. See (10) page 1200, (7) page 31, and (6).

Table 27.--Wholesale prices and daily gross receipts by product and container for the model wholesale delivery milk route [1]

Product	Size	Wholesale price			Gross receipts [2]		
		Paper	Glass	Other	Paper	Glass	Other
		Dollar					
Homogenized milk.......	5-gallon can	---	---	3.95	---	---	3.95
	$\frac{1}{2}$-gallon	.41	---	---	17.63	---	---
	Quart	.21	.2025	---	29.61	5.67	---
	Pint	.12	---	---	.12	---	---
	$\frac{1}{2}$-pint	.06	.06	---	16.14	.48	---
Grade A..............	Quart	.20	.1925	---	9.20	8.28	---
	$\frac{1}{2}$-pint	---	.06	---	---	.30	---
Half and half, coffee cream...............	Quart	.70	.70	---	7.00	4.20	---
	$\frac{1}{2}$-pint	.20	.20	---	.80	.20	---
Whipping cream.........	$\frac{1}{2}$-pint	.32	.32	---	1.60	.32	---
Chocolate milk.........	Quart	.22	---	---	1.98	---	---
	Pint	.13	---	---	.26	---	---
	$\frac{1}{2}$-pint	.07	.07	---	2.24	.56	---
Orangeade..............	Quart	.18	.17	---	.36	.17	---
	$\frac{1}{2}$-pint	.055	.05	---	.11	.15	---
Buttermilk.............	Quart	.15	.14	---	.75	.28	---
Skim milk..............	Quart	.12	---	---	.36	---	---
Cottage cheese.........	Carton	----	---	.20	---	---	6.40
Butter.................	Pound	---	---	.69	---	---	1.38
Reddi-Wip..............	Can	---	---	.47	---	---	1.88
Total by container		---	---	---	88.16	20.61	13.61
Total for route...							122.38

[1] See table 23 for volume delivered.
[2] Wholesale price multiplied by volume delivered.

on the 3 vending routes range from about 1.5 to 3.5 times as great as for the wholesale route.

Operating costs per unit delivered are lowest for wholesale route delivery--1.7 cents. Similar costs for every-other-day home delivery are slightly higher at 2 cents, but on a daily delivery basis and constant sales volume, are twice as high as the wholesale costs. The per unit operating costs on vending routes are approximately twice those of the wholesale route; 3.4 cents for the indoor vending route; 3.3 cents for deliveries to both outdoor and indoor machines and 3.7 cents for the outdoor machine route.

Table 28.--Costs of distributing milk by different methods: Based on milk distribution in Martinsburg, W. Va., 1956

Cost item	Distribution method					
	Vending 1/			Home delivery		Wholesale
	Daily indoor	Daily indoor & outdoor	Daily outdoor	Every-other-day	Daily 2/	Daily
Units delivered	1,538	1455	1250	770	385	719
Operating cost	$51.83	$47.39	$46.86	$15.12	$15.12	$12.19
Sales returns	153.80	155.48	300.00	168.18	84.09	122.38
Operating cost/unit	.034	.033	.037	.020	.039	.017
Operating cost/sales dollars	.3370	.3048	.1562	.0899	.1798	.0993

1/ Operating cost and sales value at break-even point. If sales are increased, delivery costs would decline both per unit and per dollar of sales.

2/ Converted from every-other-day to a daily delivery basis assuming no change in cost for reduced volume or in number of stops.

The net returns for vending and home delivery routes are computed on the basis of spread between wholesale cost and selling price. Thus, the analysis is directly applicable to operations of independent vending machine operators or "bob tailers" who buy the packaged milk and dairy products they deliver. There is implicit in this analysis, an additional margin or cost advantage to a processor operating similar routes that is at least equivalent to his cost of wholesale delivery. 27/ For example, with a margin of 3.37 cents per unit, the break-even sales volume of the model indoor vending route was computed to be 1,538 ½-pint units (page 14). A processor would have 5.1 cents average margin and would need a sales volume of only 897 ½-pint units to break even on this same route due to

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27/ Additional margin may accrue to the plant operator through increased efficiency or through lowered plant costs per unit processed resulting from increased volume handled.

his cost advantage (fig. 1). Thus, it may be to the processor's advantage to operate vending or retail routes that appear to have extremely high operating costs or to operate at a lower volume than the break-even point for independent vending machine operators and bobtailers.

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